BEING LIKE YOU IMPROVES MY COMFORT SPACE: SOCIAL HUMAN-VIRTUAL CONFEDERATES INTERACTIONS

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Abstract. This study aims to explore how the comfort distance between a person and a virtual avatar (interpersonal comfort-space, IPS) is modulated by body characteristics during a social interaction. Once immersed in a virtual scenario, participants could either see virtual agents approaching them (passive condition) or moved towards them (active condition). In both conditions, participants had to press a button as soon as they felt that the distance between them and the avatar was uncomfortable. Importantly, participants could have similar or different (i.e. smaller) body-size compared to the avatar. Results showed that participants with different body size preferred larger distances as compared to those with similar body size, particularly in the passive condition. Finally, the different body size participants in the passive condition showed a gradual increase of comfort-distance with the decrease of their arms' length. These results suggest that the possibility of control modulates IPS: people prefer a larger comfort-distance when can only observe virtual agents with a big body size approaching them. Therefore, the IPS increase may reflect an evolutionary mechanism of self-protection that determines an automatic avoidance reaction to a potential violation of the near body space.

Keywords: interpersonal comfort-space, avatar, body-size.

1 Introduction

In the last decades, the Immersive Virtual Reality (IVR) systems are becoming increasingly popular in clinical and research fields [1]. The concept of "presence" or "the feeling of being there" describes the quality of our subjective experience in IVR [2; 3]. When the virtual environments are populated by virtual agents, we may have the feeling of interacting with them as if we were together with other individuals in actual contexts, a feeling referred to as 'social presence' [4-6].

The capacity of IVR to convince a user to be in reality can represents a viable solution for medical, rehabilitative, social and psychological purposes [3]. The presence of naturalistic virtual agents is useful to help users, particularly elderly and clinical populations, to perform the assigned task [1]. Therefore, it is important to understand in which way the characteristics of virtual agents may affect the quality and the efficacy of virtual social interactions.

Proxemics studies have shown that the use of space during interactions is a good measure of the quality of social interactions [7]. The "interpersonal comfort-space" (IPS) represents the optimal distance between ourselves and others, that is our emotional 'private space' [8]. Typically, people increase IPS in uncomfortable/threatening situations and reduce IPS in comfortable/safe situations [8-9]. Recent studies using IVR have demonstrated that IPS is modulated by the socio-emotional characteristics of the virtual confederates such as age, gender and facial expressions [4; 6; 10-12]. The physical characteristics of interactants (e.g., height) may also modulate IPS. Pazhoohi et al. [13] found, for example, that comfortable IPS was positively associated with height of male participants. Body size can represent a signal of threat/weakness provoking avoidance behaviors or dominance/competition provoking approach behaviors [14].

In sum, individuals' body size could represent a key factor in modulating the extension of IPS during interactions with virtual agents. To our knowledge, no study has addressed this issue so far. Here, we tested the effect of body size similarity on IPS during virtual interactions by dividing male participants in two groups: similar body size as virtual confederates (Similar Body Size group), different body size from virtual confederates (Different Body Size group). Participants determined comfort-distance from virtual agents under two approach conditions: while standing still (passive) or walking toward the virtual confederates (active).

We expected that comfort-distance should be shorter with similar than different body size. Since when we can actively control the spatial behavior we feel safer [10], we hypothesized comfort-distance should be smaller in the active than passive condition. However, the passive condition should determine an expansion of distance especially within the dissimilar body size group.

2 Method

2.1 Participants

Thirty-one right-handed male participants, aged 18-26 years (Mean= 21.5; SD= 2.2), participated in the study. Seventeen participants with similar body' size as the virtual confederate (h.= 1.78m, arms' length= 76cm) were assigned to the "Similar Body size group" (h.= 1.77m; arms' length=75.2cm); 14 participants with shorter body' size from the virtual confederate were assigned to the "Different Body size group" (h.= 1.70m; arms' length= 71.7cm). Participants had common experience with digital technology but no one with virtual reality devices. Nobody claimed discomfort or vertigo during the IVR experience.

2.2 Settings and apparatus

The IVR equipment was installed in a 5x4x3 m room of the Laboratory of Cognitive Science and Immersive Virtual Reality (CS-IVR, Dept. Psychology). The equipment included the 3-D Vizard Virtual Reality Software Toolkit 6 (Worldviz, LLC, USA) with the head mounted display (HMD) HTC VIVE. A glove with 14 tactile-pressure sensors allowed the participants to ‘‘see’’ and ‘‘feel’’ their arm movements (Data Glove Ultra; WorldViz, USA).

2.3 Virtual stimuli

The virtual room consisted of green walls, white ceiling and grey floor. Twelve realistic confederates with neutral facial expressions were used [10-11].
Virtual humans represented male adults aged about 26 years, wearing similar casual clothes and looking like Italians (Fig. 1). Their gaze was kept looking straight ahead through-out the trials.

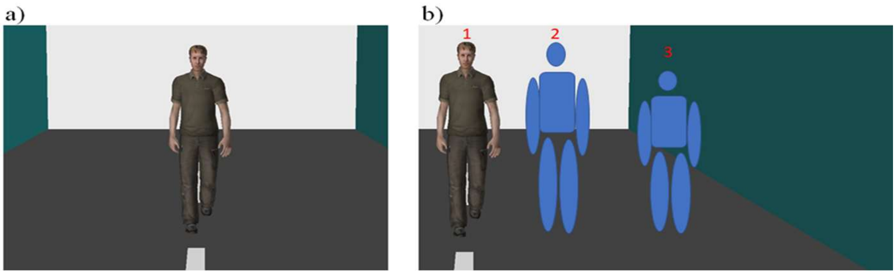

Fig. 1. The figure depicts *a)* a virtual confederate approaching frontally participants; *b)* the virtual confederate (1) compared to participants had similar (2) or different (3) physical characteristics.

2.4 Procedure

After wearing the HMD and the Data Glove participants were immersed in the virtual scenario and could perform extensive exploratory movements. Next, they were led to the starting position where they held a keypress device in their dominant hand. The experimental session comprised two Passive and Active blocks in a counterbalanced order. The comfort-distance instruction for both approach conditions was: ‘‘press the button as soon as the distance between you and the confederate makes you feel uncomfortable’’. After button press, virtual confederates disappeared. Each virtual confederate appeared 4 times (quasi-randomized order) resulting in 24 per block (tot. 48 trials).

3 Results

The mean participant-virtual confederate distances were analyzed through a 2x2 ANOVA with terms Groups (between) and Approach (within). A main effect of Groups emerged (F(1,29)= 17.498, p=.001, η^2_p = .38) due to Different body size group (M=61.34cm, SD=38.23cm) preferring a larger distance than Similar body size group (M=29.33cm, SD=13.29cm). A main effect of Approach condition emerged (F(1,29)= 22.906, p < .001, η^2_p = .44) due to a larger distance in the passive (M=59.51cm, SD=33.81cm) than active (M=28.06cm, SD=20.25) approach. A significant Groups x Approach interaction was found: F(1,29)= 8.566, p < .01, η^2_p = .23 (see Fig. 2). The Scheffè post-hoc test revealed that within the Different body size group, passive approach was larger than active one (p< .001); whereas within the Similar body size group, no difference emerged. Finally, a negative Pearson correlation (see Table 1) between arms' length and Different body size group in the passive approach emerged by demonstrating a gradual increase of comfort-distance with the decrease of the length of participants' arms. No other significant correlations emerged.

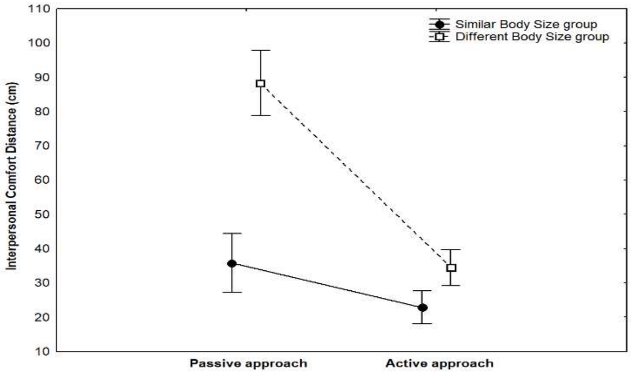

Fig. 2. The graph shows mean comfort distance (cm) for each group as a function of passive and active approach conditions. Error bars represent standard errors.

Table 1. Descriptive statistics and correlations between arms' length of both groups (N=31) and the IPS distance for passive and active approach conditions; ^p= .12; *p< .05.

Groups	Arms' length (M:Sd)	Passive approach	Active approach
Similar Body Size	76.0; 1.8	.40^	.21
Diff. Body Size	71.1; 2.8	**-.50***	-.31

4 Conclusions

The results confirmed that comfort-distance was larger when participants had a shorter instead of similar body size as compared to virtual agents. The passive approach provoked a general enlargement of the IPS with respect to the active one. This is in line with previous evidence showing an increase of IPS when we do not have the full motor control of spatial behavior, thereby reflecting a low feeling of safety [6; 10]. Importantly, IPS was increased only in the passive approach condition when participants had a different rather than similar body size as compared to the virtual agents. The correlational analysis demonstrated that different body size participants in the passive condition reported a gradual increase of comfort-distance with the decrease of their arms' length.

Therefore, body size is an important factor in the modulation of IPS [13]. Along with social-emotional factors, the body size of a smaller individual can represent an element of weakness during social interactions with taller interlocutors. By contrast, being physically similar to our interlocutors gives us the possibility to manage the interaction in terms of competition at par, thus allowing behaviors of approach [14].

In line with an evolutionary perspective, these findings are consistent with the fundamental defensive function of the near body space representation [15]. The need of maintaining a feeling of safety is crucial when the person who enters in our space is perceived as potentially harmful, and this provokes an automatic avoidance reaction [6; 9-10].

The current study focused only on male dyadic interactions and this can be a limitation. Further studies should investigate whether the interactions between women of similar or different body sizes can replicate the same findings reported here.

In sum, if we want to improve the quality and efficacy of virtual social interactions it is particularly interesting the finding that IPS is shorter when individuals and virtual agents are physically similar. This is in line with the evidence that when other persons are perceived as similar to us, we tend to approach them to facilitate the social interaction [13-14].

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